Research Masters in Economics

Democracy and Fertility*

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July 21, 2011

Abstract

This research is an empirical assessment of the causal relationship between democracy and birth rates. The question under study is whether a country is more likely to experience fertility declines as it becomes more democratic, holding the other country's characteristics constant. This study goes beyond the existing literature to establish a causal relationship between democratization and fertility declines. To establish a causal relation we adopt two complementary strategies. The first is to include country fixed effects in the estimation and the second is to use an instrumental variables approach. The results suggest a robust negative causal relationship between democracy and birth rates. We interpret the effect of political rights on fertility as stemming from a decrease in overall societal risk, which diminishes as political institutions mature.

JEL Classification: D72, J13
Keywords: Democracy, Political Institutions, Birth Rates

*Financial support from *Fundação para a Ciência e Tecnologia* is acknowledged.

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Foremost, I would like to express my sincere gratitude to my advisor José Tavares for the insightful conversations, guidance, and inspiration.

Special thanks also goes to Pedro Portugal for his encouragement, dedication and endless support. Without the econometrics knowledge he taught me, and still does, this research wouldn't be possible.

My sincere thanks to Ana Balcão Reis, for her motivation and friendship.

I thank my friends Miguel Faria e Castro and Nuno Paixão for the nights we were working together in "our" office and for the fun we had in these years. Thanks for being patient with me. I will miss you.

I also thank my friends Diana Fernandes and Diana Bernardes for their energy and motivation.

I would like to thank my family for being always by my side and Eduardo for his care, patience and love. This thesis is dedicated to him.

1 Introduction

The world economies have experienced an unprecedented demographic transformation, characterized by a significant reduction of fertility rates and population growth, over the past decades. The persistent decrease in fertility rates is depicted in Figures 1 and 2. These figures show a simultaneous sharp decline in fertility levels to a record level.

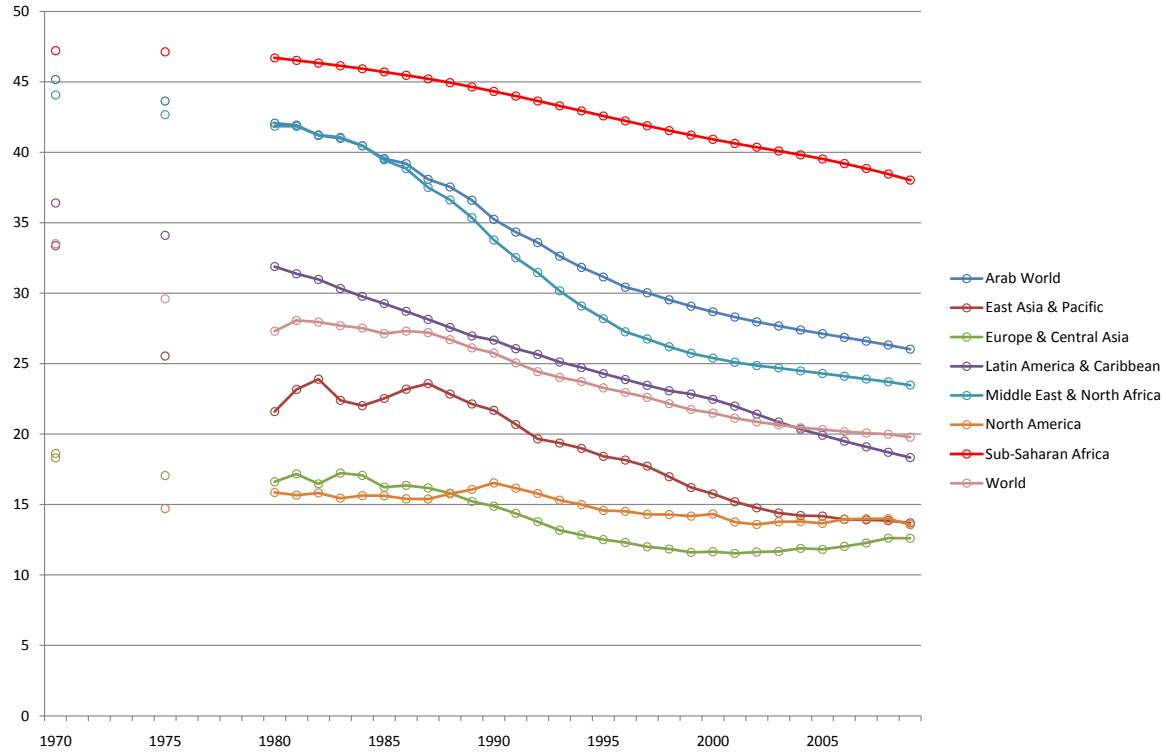

Figure 1 – Crude Birth Rate Evolution by Region

Notes: For detailed data definitions and sources see the Appendix Table A1.

Various mechanisms have been pointed as triggers for fertility declines and the reduction of population growth that characterized the world in the past century. Galor (2005) presents an assessment of the main determinants of fertility declines advanced by demographic transition theories. The author points four main mechanisms to

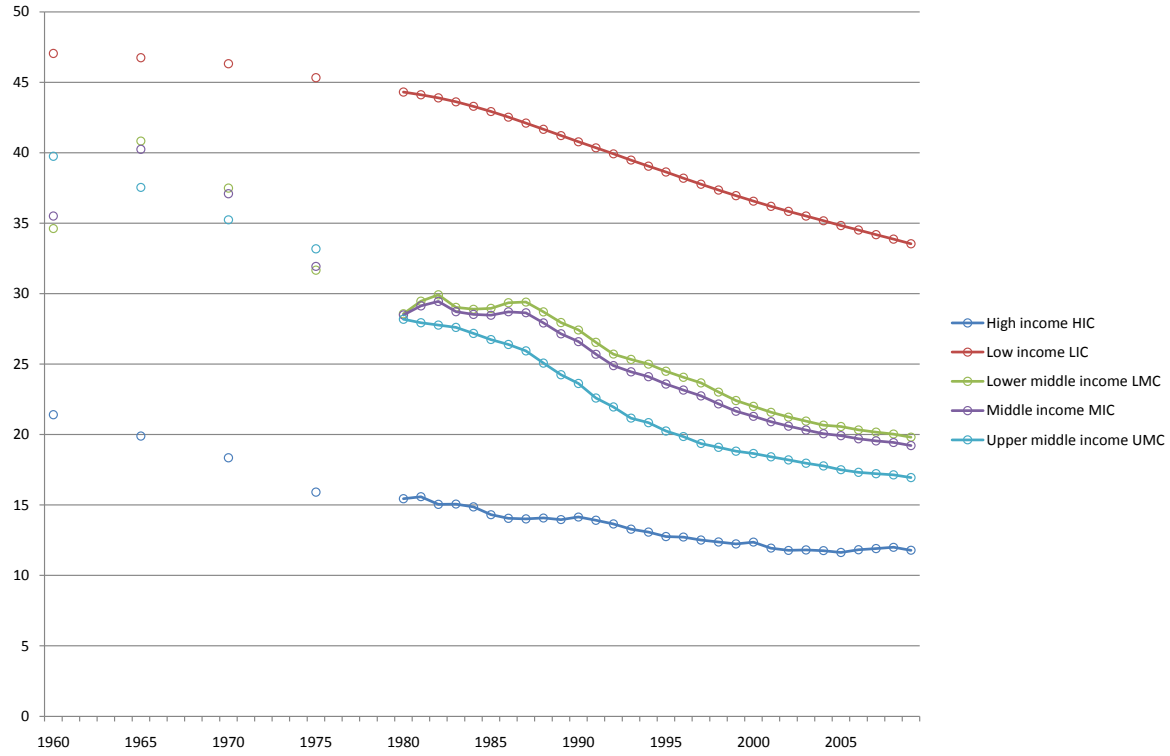

Figure 2 – Crude Birth Rate Evolution by Income Level

Notes: For detailed data definitions and sources see the Appendix Table A1.

explain the reduction in fertility experienced across the various regions of the world.

One of the highlighted mechanisms is the rise in the level of income per capita and the substitution effect of quality for quantity of children, explained by relative higher wages paid to women in developed economies, therefore increasing the opportunity cost of child rearing (Becker, Murphy, and Tamura, 1990)[1]. Galor (2005) argues that this theory is counterfactual since countries across Western Europe with considerably different income per capita observed a simultaneous demographic transition and

[1]Becker (1981) suggests that the demographic transition occurs since at high levels of income the positive income effect on child bearing is dominated by the negative impact of the opportunity cost of children. Fernandez-Villaverde (2004) studies the demographic transition in England and demonstrates that in contrast to the Becker's theory, which says that an increase in income would lead to fertility declines, a rise in income would have resulted in a further increase in fertility rates.

therefore, the role of high levels of income in explaining fertility declines is limited.

A second mechanism relies on the role of human capital accumulation. Galor and Weil (1999, 2000) proposes that the acceleration of technological progress and its impact on the demand for human capital contributed to the onset of the demographic transition through two main effects. First, technological improvement allow households to spend a higher portion of resources in child quality as well as in child quantity. And second, it allows these increased resources to be reallocated towards higher investment in human capital for each child[2].

A third mechanism to explain fertility declines is the decline in the gender gap. The rise in women's relative wage and education associated with a higher female labor market participation leads to fertility declines as women's time becomes more expensive and the opportunity cost of rearing children increases. Galor and Weil (1996, 1999) proposes a theory of fertility decline associated with a decrease in the gender wage gap. More recently, Lagerlöf (2003) proposes that as women's human capital becomes more similar to that of men, making their time more expensive, couples substitute quality for quantity in children and fertility falls as a consequence[3].

The last mechanism pointed by this author is the decline in infant and child mortality. Galor (2005) argues that this explanation is inconsistent with historical evidence since the increase in income per capita in the Post-Malthusian Regime increased the desirable number of surviving offspring and so fertility rates increased significantly, despite the decline in mortality rates. The quantitative analysis by Fernandez-Villaverde (2004) and Doepke (2005) suggest that the decline in infant mortality rates was not a determinant of fertility declines during the demographic transition.

Other mechanisms such as the old-age security hypothesis which suggests that in the absence of capital markets parents see children as assets that allow them to smooth the consumption over lifetime are also present in the literature. With the

[2]Other factors can be pointed as underlying this second mechanism. The new role of human capital in the production process induced education reforms (see, for example, Galor and Moav (2003, 2004)) and laws to abolish child labor (see, for example, Doepke and Zilibotti (2003)) contributing to a decrease in child labor and, as a consequence, on fertility rates. The increase in the expected length of productive life as a result of the rise in life expectancy increased the potential rate of return of investments in children's human capital. The cultural and genetic evolution of individuals' preferences towards the quality of children triggered the investment in human capital and the substitution of quality for quantity of children, reinforcing fertility declines.

[3]See, for example, Rahim and Tavares (2011) for a more recent study.

establishment of capital markets this hypothesis looses power since this motivation for rearing children becomes residual.

These theories of demographic transition are unanimous on the relation between the number of children parents decide to have and the opportunity cost of childbearing, but the majority have remained silent on the institutional conditions that contribute to change the relative costs and preferences of having children, thus reinforcing fertility declines.

We argue that politics critically influence the environment within which individuals make childbearing decisions. The argument is that the country's political environment is a determinant of fertility decisions by changing the opportunity cost of having children. We follow the political economy literature, namely Tavares and Wacziarg (2001), Rodrik, Subramnian, and Trebbi (2004) and Persson (2005), and argue that democracies encourage an open debate about policies and policy-makers, a regular scrutiny and a meaningful opposition preventing power abuses and lowering uncertainty about future policies. The improvement in economic performance and the lower uncertainty associated with democracies both increases the opportunity cost of children and promote fertility declines. Democracies promote a more stable economic environment by enhancing property rights and favoring contract enforcement, thus increasing the returns to investment in physical and human capital.

In this framework, this paper investigates the role of democracy in explaining fertility declines experienced worldwide on the last decades. The starting point of this study is the cross-country empirical evidence on the relationship between democracy and fertility rates. We revisit these studies and focus on the within variation rather than on the cross-sectional variation to establish a causal relationship. The question we want to address is whether a country is more likely to observe fertility declines as it becomes more democratic, holding other country characteristics constant.

The cross-sectional empirical evidence on the negative relationship between democracy and birth rates is established ignoring three very important issues. First, and importantly, there is the potential for omitted variable bias. The political economy literature, for example Huntington (1991), pointed the importance of cultural values, traditions, institutionalization, and ideologies in explaining democratization. These factors are also likely to be correlated with birth rates behavior. Democracy may proxy for an important combination of these factors. Recent work by Acemoglu, Johnson,

Robinson, and Yared (2005, 2008) shows that two basic tenets of the modernization thesis, popularized by Lipset (1959), which says that richer and more educated nations become more democratic, are not robust to the introduction of country fixed effects. Empirical evidence that more educated and richer nations are more democratic vanishes once the authors control for omitted permanent factors.

Second, these studies ignore the high persistence in birth rates and do not consider any dynamics in the estimated models. We will use dynamic panel data methods in order to deal with persistence in birth rates while accounting for unobserved individual-specific effects. Since the variable Crude Birth Rate is highly correlated over time it is crucial to model dynamics in order to disentangle and better understand which factors influence the individual's behavior over time.

And third, there is the possibility of reverse causality, with economies with very young population contributing to democratic transitions. The young population structure has been emphasized as a trigger for the Arab Spring that started in the late months of 2010 in the Arab World (namely in Tunisia, Egypt and Libya)[4].

To answer the question under study taking these issues into consideration seems overwhelming. However, we find that two estimation methods are well suited to deal with these problems. The first is the fixed effects estimation, which allows for unobserved country individual heterogeneity that may be correlated with exogenous regressors, and the second is the instrumental variables estimation. The first method allows us to control for time-invariant country-specific factors[5] which affect both variables, and to look at the "within-country variation" instead of simple cross-country comparisons. The second approach to estimate the relation between democracy and birth rates relies on the use of instrumental variables which is a promising way of dealing with endogeneity. We use a measure of the neighbors democratic capital proposed by Persson and Tabellini (2006) as an instrument for democracy.

Figures 3 and 4 plot the variation in the democracy index and in the logarithm of income per capita, respectively, against the variation of the logarithm of Crude Birth

[4]For example, according to the United Nations Population Division, in 2010, 19% of the tunisian population aged between 15 and 24 years old in 2010. This young structure of the tunisian population is pointed as a very important factor for the precipitation of the Tunisian revolution which began in December 2010 that is commonly referred as the Youth Revolution.

[5]If the omitted factors affecting birth rates and correlated with the political and economic variables are time-variant then the fixed effects estimation does not help to improve inference.

Rates, over the period of 1972-2006. In contrast with income per capita, no clear relation between democratization and birth rates can be drawn directly from Figure 3.

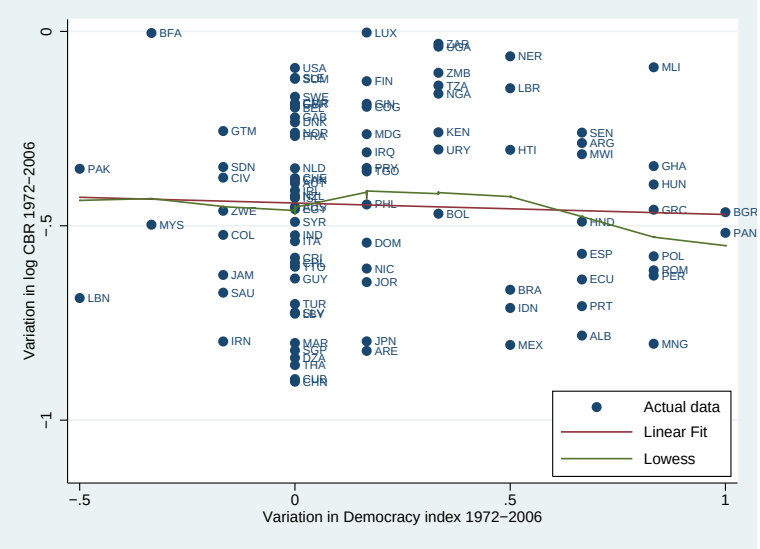

Figure 3 – Democratization and Fertility Rates: 1972-2006

Notes: Variation corresponds to the total difference between 2006 and 1972. The red line represents a fitted OLS line of the variation of the logarithm of CBR on the variation of the democracy index. The green line is fitted by a nonparametric regression using the locally weighted scatterplot smoothing estimator (lowess). See the appendix table for data definitions and sources.

This paper is organized as follows: Section 2 presents related literature. Section 3 presents the data. Section 4 introduces the econometric methodology used. Sections 5 and 6 discuss the empirical results and empirical robustness. Section 7 concludes.

2 The Literature

Demographers, political scientists and economists provide theoretical backgrounds to explain the fertility declines verified in the greater part of the countries in the world. The main criticism pointed at these theories of demographic transition which try to explain fertility declines is that they remain silent as to what concerns the role of a country's political environment and characteristics in affecting the individuals' child-

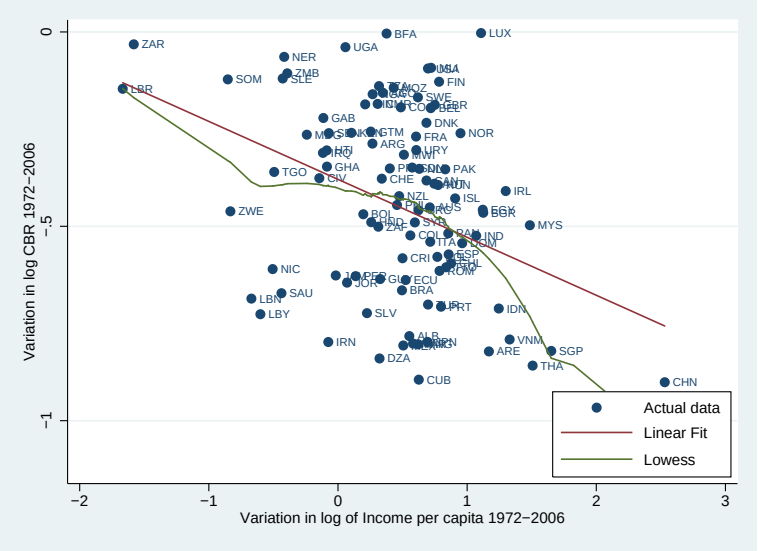

Figure 4 – Economic Development and Fertility Rates: 1972-2006

Notes: Variation corresponds to the total difference between 2006 and 1972. The red line represents a fitted OLS line of the variation of the logarithm of CBR on the variation of the logarithm of income per capita. The green line is fitted by a nonparametric regression using the locally weighted scatterplot smoothing estimator (lowess). See the appendix table for data definitions and sources.

bearing decisions by changing the societal risk and therefore contributing to explain fertility declines.

Organski, Kugler, Johnson, and Cohen (1984) are among the first to propose that fertility declines are not simply a result of modernization but rather can be triggered by either economic or political institutions. These authors revealed that politically capable governments are able to induce fertility declines even at the lowest levels of social-economic development. Indirect effects of governmental activity on fertility arise from transformation of the infrastructure, improvements in public health and legislation that increases education and employment opportunities for women. Mason (1997) points the importance of institutional, cultural and environmental constellations to explain fertility transitions. More recently, Galor (2005) argues that the different timings of the demographic transition reflects initial differences in several factors, namely geographical and historical factors, and their impact in institutional, cultural and demographic environments.

Some empirical studies on the relation between political characteristics and fertility behavior have been presented on the last decades. Feng, Kugler, and Zak (2000, 2001) proposed a formal dynamic model of politics and economic growth, embedded in the microfoundations of decision making by government, firms and individuals. The authors estimate a cross-country time-series regression model and find empirical evidence that political stability and political capacity have a negative effect in fertility rates, after taking into account the negative impact of income. Feng (2003) develops a more parsimonious model which includes political freedom, political stability and policy certainty as the main characteristics of the political systems which influence decision makers. The author argues that these dimensions of political institutions affect the individuals' decisions by changing the opportunity cost of rearing children. The empirical results show evidence supporting the propositions that countries that are more free or more stable, and countries with less policy uncertainty display lower fertility rates. Based on the theoretical framework proposed by Feng, Kugler, and Zak (2001), Kugler and Swaminathan (2006) find that politics influence fertility choices and determine the transmission of human capital from parents to children.

In sum, existing literature establishes a cross-sectional negative relationship between political development and fertility rates. However, these results do not establish causation and are established ignoring very important issues. In this context, the main contribution of this paper is the use of an appropriate estimation framework which allows us to examine the existence of a causal relationship between democracy and fertility rates.

But how does democracy contribute to change the opportunity cost of children, thus influencing childbearing decisions?

2.1 Democracy, Dictatorship and Fertility

Przeworski (2004) finds that population grows faster under dictatorships than under democracies because the former have higher birth rates[6]. According to Przeworski (2004), under dictatorships women have on average 0.5 children more than under democracies (Przeworski (2004)). "Because their policies and their performance are

[6]This difference in birth rates is explained by higher fertility rather than by the age structure of population.

so unpredictable, they do not allow people to plan their lives, inducing households to hoard the least risky asset, namely children".

Democracy promotes regular public scrutiny and a meaningful opposition preventing policy-makers from power abuses and lowering the levels of corruption, red tape, and other types of small groups' favoritism. It promotes transparent rules and an open debate over the choice of policies and policy-makers. Also, democracy substitutes constitutional for non-constitutional transfers of power, thus hindering unpredictable and violent power transfers, such as coups d'état, lowers uncertainty about future policies and establishes a more stable environment. Furthermore, by enhancing property rights and favoring contract enforcement democratic societies reduce uncertainty about future returns from investments increasing investment in physical and human capital[7]. Engerman, Mariscal, and Sokoloff (1999) and Wacziarg (1999) provide empirical evidence that democracy is positively associated with various measures of human capital. This greater stability, confidence in institutions and protection of investors promote economic growth and raise the opportunity cost of child care and child rearing, lowering birth rates. North and Weingast (1989) argue that "The more likely it is that the sovereign will alter property rights for his or her own benefit, the lower the expected returns from investment and the lower in turn the incentive to invest. For economic growth to occur the sovereign or government must not merely establish the relevant set of rights, but make a credible commitment to them."

In this way, democracy tends to promote investment, namely in human capital, by increasing educational opportunities and increasing female participation in the labor market, therefore contributing to increase the relative cost of having children and to lower fertility rates. Rodrik (1999) shows empirical evidence that democracies pay higher wages. Heckman and Walker (1990) and Schultz (1997) study the role of women's wage on birth rates using Swedish data and find that increases in women's relative wage are an important determinant of Swedish fertility declines. Galor and Weil (1996) propose a model focused on the effect of an increase in women's relative wage in lowering fertility, which is consistent with this empirical evidence. The authors find that increases in women's wage raise both household income and the price of children, generating offsetting income and substitution effects on the demand for

[7]Rodrik (1998) presents empirical evidence supportive of the hypothesis that democracies produce greater stability in economic performance.

children. Higher wages for women increase less the household income than they raise the opportunity cost of children, leading couples to choose to have less children[8].

All in all, democracy, measured as the individuals' capacity to freely exert their options, favors economic performance improvement and human capital accumulation increasing the relative returns to work when compared with child rearing, and raising the opportunity cost of having an additional child.

3 Data and Descriptive Statistics

In this study, we use a panel of 100 countries for the period comprised between 1972 and 2006. The two employed measures of fertility are from the World Development Indicators (WDI) database: the Total Fertility Rate (TFR) and the Crude Birth Rate (CBR). The former measures the number of children that would be born to a woman if she were to live to the end of her childbearing years and bear children in accordance with current age-specific fertility rates. The latter indicates the number of live births occurring during the year per 1,000 people estimated at midyear. We will use the CBR as the dependent variable since this measure considers the country's structure of population. The two variables are highly correlated and the estimation results using either of the two measures as dependent variable are very similar[9].

We follow the existing literature and define democracy according to Gastil's (1986-1987 ed., page 7) definition of political rights. "Political rights are rights to participate meaningfully in the political process. In a democracy this means the right of all adults to vote and compete for public office, and for elected representatives to have a decisive vote on public policies". Therefore, countries with free and fair elections, in which those who are elected rule and opposition plays a meaningful role, and where individuals can freely exert their options, are considered democracies. We use the Freedom House Political Rights Index which is precisely based on this definition

[8]According to their model: increases in the capital/labor ratio raise the relative wages of women which leads women to substitute out of child rearing and into labor market; both higher wages and lower fertility increase the level of capital per worker; this effect amplifies the increase in output due to lower fertility and higher female participation in labor markets and is likely to accelerate the demographic transition process. This may lead to the enforcement of property rights and law due to the abundance of capital thus becomes easier for women to enter the labor market.

[9]Estimation results using the variable TFR as dependent variable are reported in the appendix tables 7 and 8.

in order to "measure" democracy. The basis for this indicator is a yearly survey, which evaluates political institutions in each country, based on the freedom to elect representatives and the existence of a meaningful opposition (Freedom House, 1972-2006). This index ranges from 1 to 7, with 1 representing the freest countries, say Sweden, and 7 the less free countries, say Libya. We transform the democracy index to range from 0 (full autocracy) to 1 (country with fully developed institutions).

The GDP per capita (in PPP) is from The Penn World Table 6.1. Other variables are discussed later, once introduced in the analysis. A detailed description of the variables and sources can be found in the Appendix Table A1. Table 1 presents descriptive statistics for the main variables. This table reports means, standard deviations, minimum and maximum statistics and also the total number of observations, correspondent to the sample used in the baseline estimation. Table 2 is a table of simple correlations of the main variables included in the estimation. Notice the high correlation between democracy and the logarithm of income per capita, as well as the negative correlation between democracy and the indicators of fertility.

Table 1 – Descriptive statistics

Variable	Mean	(Standard Deviation)	Minimum	Maximum	Observations
Log CBR	3.252	(0.52)	2.041	4.049	3484
Log TFR	1.255	(0.559)	0.077	2.166	3475
Log GDP per capita	8.593	(1.157)	5.032	11.248	3483
Democracy	0.524	(0.374)	0	1	3471

Notes: The sampling period goes from 1972 to 2006. For detailed data definitions and sources see the Appendix Table A1.

4 Econometric Model

4.1 Model Specification and Estimation

Consider the following dynamic regression model specified to assess the empirical causal relation between democracy and birth rates:

Table 2 – Correlation matrix for the main variables

Variable	Log CBR	Log TFR	Democracy	Log GDP per capita
Log CBR	1.0000			
Log TFR	0.9845	1.0000		
Democracy	-0.6332	-0.6301	1.0000	
Log GDP per capita	-0.8319	-0.8127	0.5970	1.0000

Notes: The sampling period goes from 1972 to 2006. For detailed data definitions and sources see the Appendix Table A1.

$$y_{it} = \gamma y_{it-1} + \delta d_{it-1} + \mathbf{x}'_{it-1}\beta + \alpha_i + \varepsilon_{it} \tag{1}$$

where y_{it} is the logarithm of CBR for country i in year t. The lagged value of this variable is included in the right-hand side in order to capture the high persistence in CBR. The variable d_{it-1} is the lagged value of the democracy index and is the variable of primary interest in this study. The parameter δ measures the causal effect of democracy in birth rates. The vector $\mathbf{x}_{it-1}$ includes lagged time-varying political and economic variables that constitute potential covariates and β is a vector of coefficients, which is assumed to be constant across countries. Additionally, the term α_i denotes a full set of country fixed effects and ε_{it} is a zero mean disturbance term capturing all other omitted factors. Country fixed effects are included in the model to account for the time-invariant country characteristics that affect birth rates.

In the model specification which constitutes the basis for the analysis the vector $\mathbf{x}_{it-1}$ includes a control for the modernization theory, the logarithm of the GDP per capita. The right-hand-side variables are included in the regression lagged by one period. We argue that parents adjust to the political environment adopting a sequential decision-making strategy that takes time to occur. Parents respond to changes in the political environment and adjust the family size contingent on that. The contemporaneous effect reflects decisions taken in the recent past, given the changes in the political environment.

The regression analysis most commonly used in the literature is the pooled OLS ignoring the high correlation of CBR over time and without including country fixed effects. A pooled OLS approach, assumes that α_i is iid $[0, \sigma^2]$ and hence that it is

uncorrelated with the regressors, leading to inconsistent parameter estimates if there is correlation. The specification of this regression is identical to equation (1) except for the omission of the lagged CBR (i.e., the γy_{it-1}) and the country-specific effects (i.e., the α_i's). Given the inertia in the CBR it is crucial to estimate a dynamic model which accounts for the high correlation of CBR over time in order to disentangle and better understand which factors influence childbearing decisions over time.

A well known result in econometrics is that OLS estimation of a dynamic regression model leads to inconsistent estimation of the parameters γ, δ and β since the regressor y_{it-1} is correlated with the random effect α_i and therefore with the composite error term $(\alpha_i + \varepsilon_{it})$. Let x^j_{it-1} denote the jth component of the vector $\mathbf{x}_{it-1}$ and $Cov(.)$ denote the covariance between the two variables. A special feature of the within estimator is that it yields consistent estimates in the fixed effects model even if these covariances are different from zero as long as $Cov(d_{it-1}, \varepsilon_{it}) = Cov(x^j_{it-1}, \varepsilon_{it}) = 0$ for all j, as T converges to ∞.

The fixed effects panel approach is of particular relevance in this study given the potential for political, social, cultural and historical omitted factors underlying both equilibrium political institutions, birth rates and economic development. This approach is attractive since it allows to establish causation under weaker assumptions than the ones required by the cross-sectional analysis as explained above. Nevertheless, some assumptions are required and a key assumption is that the unobservables α_i are time-invariant.

Furthermore, the fixed effects model has important weaknesses that must be taken into account, besides the impossibility of estimation of the coefficients of any time-invariant regressor. First, by construction, y_{it-1} is correlated with u_{is} for $s < t$ which causes the within estimator to be biased. Second, reverse causation of birth rates on democracy would imply that $Cov(d_{it-1}, \varepsilon_{it}) \neq 0$ and result in inconsistent estimates. The estimation strategy we propose to deal with the limitations of the within estimator is the instrumental variables regression analysis. We use a measure of the neighboring countries' democratic capital proposed by Persson and Tabellini (2006) as an exogenous source of variation for democracy. The estimation results from IV estimation are presented in Section 6.

5 Fixed Effects Estimation

5.1 Main Results

We start by estimating (1) and the main results are presented in Table 3.

The conventional specification is replicated in column (1) of Table 3. In this approach, a pooled OLS approach without controlling for time-invariant country-specific effects and without modeling a dynamic structure is used. The results suggest a significant negative relationship between democracy and birth rates as well as a negative effect of the logarithm of income per capita on birth rates. More democratic countries are predicted to have lower birth rates even after we control for the effect of income. The results are also consistent with the modernization theory which says that countries with better standards of living have lower fertility rates. A 10 percent increase in income per capita is associated with a 2.75 percent decrease in birth rates. In contrast, the estimation results predict that an autocracy that becomes a democratic country experiences a 40.2 percent decrease in birth rates, a considerable impact. In the second column use lagged values of democracy and income per capita and augment the basic model by introducing a lag of the logarithm of birth rates as a regressor. The magnitude of its coefficient is very large and close to one (suggesting a unit root process), and highly significant, which illustrates the strong degree of persistence in CBR and the importance of modeling a dynamic structure in estimation. The results change dramatically in magnitude and both democracy and income per capita become statistically insignificant at conventional significance levels. Therefore, we don't find empirical evidence for a significant negative cross-country relation between democratic development and birth rates once we account for the strong degree of persistence of CBR. The same result applies in what concerns the cross-country negative relation between income per capita and birth rates.

The third column of this table reports the fixed effects estimates consistent with the model presented in (1). Once we control for the presence of long-lived country-specific factors affecting birth rates and consider a dynamic model we find a significant negative impact of democratic development in birth rates. A transition from a dictatorship to a democratic regime would cause birth rates to decrease by 0.59 percent, approximately. The implied cumulative impact of democracy in birth rates (long

Table 3 – Democracy and Birth Rates

	Pooled OLS (1)	Pooled OLS (2)	Fixed Effects (3)	Arellano-Bond GMM (4)
Democracy	-0.402***			
	(0.0919)			
Log GDP per capita	-0.275***			
	(0.0297)			
Log CBR_{t-1}		1.002***	0.992***	0.9562***
		(0.0021)	(0.0047)	(0.0176)
$Democracy_{t-1}$		0.0036	-0.0059**	-0.0365***
		(0.0023)	(0.0029)	(0.0101)
Log GDP per $capita_{t-1}$		-0.0009	0.0076***	-0.0168*
		(0.0009)	(0.0024)	(0.0104)
Implied Cumulative		-1.5460	-0.7673*	-0.8342***
effect of Democracy		[0.2477]	[0.0945]	[0.0015]
Implied Cumulative		0.3858	0.9782	-0.3835***
effect of Income per capita		[0.5651]	[0.1910]	[0.0036]
Sargan test				[0.1234]
AR(2) test				[0.8477]
Observations	3455	3345	3345	3245
R^2	0.666	0.998	0.980	

Notes: The dependent variable is the logarithm of Crude Birth Rate and the sampling period goes from 1972 to 2006. Pooled cross-sectional OLS regressions in columns (1) and (2) with robust standard errors clustered at country level in parentheses. Fixed effects OLS regression results in column (3) with country fixed effects and robust standard errors clustered at country level in parentheses. Column (4) reports estimation results using the Arellano-Bond estimator (see Arellano and Bond (1991)) with two lags used to instrument democracy and with robust standard errors. The Sargan test is a test of overidentifying restrictions and the p-value for this test is in brackets. AR(2) is a test of serial correlation of order 2 that we reject at order 1 but do not reject at order 2, which is evidence of no serial correlation in the error term. The implied cumulative effect of democracy on birth rates is obtained by $democracy_{t-1}/(1 - \log CBR_{t-1})$ and the same applies for the implied cumulative effect of income per capita. The p-value given in brackets corresponds to a nonlinear test of the statistical significance of this coefficient. $^*p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$. Detailed data definitions and sources given in the appendix.

term effect) which is given by -0.0059/(1-0.992)=-0.7673 is marginally statistically significant. The estimates predict a significant even though small positive impact of income per capita in birth rates which is not consistent with the modernization theory. Nevertheless, the predicted long-run effect of income per capita is not statistically significant. Overall, the statistical significance of the negative relation between democracy and birth rates is robust to the introduction of country-specific fixed effects and to modeling a dynamic structure, but the predicted impact is dramatically small when compared with the results given in column (1), which replicates the results in the literature.

The inclusion of a lagged dependent variable as a regressor in the model raises several problems related with the pooled OLS and the within estimators. As Joshua D. Angrist wrote in reply to a reader comment: "So I say: "You want to do fixed effects? No lagged dependent variable, please (or at least be prepared to instrument it if you include one). You want to control for lagged dependent variables? Then, just do it!""[10]. Estimation of a dynamic model by pooled OLS, fixed effects or even by random effects leads to inconsistent estimates of the parameters. Nickell (1981) shows that standard OLS estimation methods lead to downward-biased coefficients in dynamic models. This effects is commonly known as the "dynamic panel bias" or "Nickel bias". Consider the specific case of the within estimator (or fixed effects estimator), which regresses $(y_{it} - \bar{y}_i)$ on $(y_{it-1} - \bar{y}_i)$ and $(\mathbf{x}_{it-1} - \bar{\mathbf{x}}_i)$. By construction y_{it} is correlated with the error term ε_{it}, so y_{it-1} is correlated with ε_{it-1} and therefore with $\bar{\varepsilon}_i$. And this implies that the regressor $(y_{it-1} - \bar{y}_i)$ is correlated with $(\varepsilon_{it} - \bar{\varepsilon}_i)$, which is the error term of the previous regression.

This inconsistency of standard panel data estimators in the case of regressors including a lagged dependent variable led to new microeconometric approaches that we will use as estimation strategy.

Model (1) leads to the first-differences model

$$y_{it} - y_{it-1} = \gamma(y_{it-1} - y_{it-2}) + (\mathbf{x}_{it-1} - \mathbf{x}_{it-2})'\beta + (\varepsilon_{it} - \varepsilon_{it-1}), \quad t = 3, ..., T \qquad (2)$$

[10]This is an answer to reader's comment of the book by Angrist and Pischke (2008) on the website www.mostlyharmlesseconometrics.com

Handerson and Hsiao (1981) proposed estimating (2) using y_{it-2} as instrument for $(y_{it-1} - y_{it-2})$, since it is not correlated with $(\varepsilon_{it} - \varepsilon_{it-1})$, assuming the errors are serially uncorrelated, and is correlated with $(y_{it-1} - y_{it-2})$. Alternatively one can use Δy_{it-2} as an instrument for Δy_{it-1}. Arellano and Bond (1991) propose a panel GMM estimator using additional lags of the dependent variable as instruments. This method is designed for models with a large N and a small T and has the particular advantage of using the lagged values of the variables as instruments for themselves. This allows the researcher to overcome the problem of finding a good (valid) instrument to use in estimation. The GMM estimation has also the advantage of allowing us to test for the validity of the overidentifying restrictions once it uses multiple instruments (the most commonly used test is the Sargan test) and for serial correlation in the error term. The AR(2) test for autocorrelation in the error term allows us to conclude about further correlation in the error term. According to the model formulation in (2) we expect to reject the null hypothesis of no serial correlation at order 1 but not at higher orders.

We use the Arellano and Bond GMM estimator and present the results in column (4) of Table 3. The results in column (4) show empirical evidence for a significant negative relation between democracy and birth rates. The short term and the long term effects of democracy in birth rates are statistically significant. According to the estimates, a full development of institutions leads birth rates to decrease by approximately 3.7 percent in the short term while the predicted impact in the long term is equal to 83 percent, which is a quantitatively larger impact than that estimated in column (3). Furthermore, income per capita appears as a negative determinant of birth rates. A 10 percent increase in income per capita is associated with a 0.17 percent decrease in birth rates. The long-run effect of income per capita is equal to -0.38 implying that a 10 percent increase in income per capita leads to a 3.8 percent decrease in birth rates in the long term. The Sargan test results allow to conclude that the multiple instruments are valid and the AR(2) test results allow to reject the null hypothesis of serial correlation at order 1 but not at higher order. These two tests provide empirical robustness to the estimates by validating the instruments used in the GMM estimation.

Overall, these results show robust empirical evidence for a causal relationship between democratic development and birth rates. The magnitude of the impact is

well below the one predicted by standard regressions in the literature.

5.2 Robustness

In this section we analyze the sensitivity of our results to two modifications of the model. Firstly, we will examine the sensitivity of our results to the inclusion of additional covariates in the regressions. And secondly, we will use an alternative measure of democracy from the Polity IV database and investigate the robustness of the estimates.

5.2.1 Sensitivity to the introduction of additional covariates

In this section we investigate how the relationship between democracy and birth rates is influenced by the introduction of other covariates in the regressions. The new covariates include a measure of human capital from Persson and Tabellini (2006) constructed by interpolating the five-year observations from Barro and Lee (2000) on the years of schooling of the population above 25 years of age, and a measure of female labor market participation from the World Development Indicators database. The labor force participation rate is the proportion of female population ages 15 and older that is economically active. Table 4 investigates the sensitivity of our results to the introduction of these additional covariates.

Columns (1) and (4) include human capital, columns (2) and (5) include female labor market participation and columns (3) and (6) include both variables in estimation. We present both fixed effects and GMM estimates.

The fixed effects estimates show that once human capital and female labor market participation are included in the estimation the relationship between democracy and birth rates disappears and becomes statistically insignificant. In this specification, female labor market participation is not statistically significant while human capital is highly significant. According to column (3) an additional year of schooling of the population above 25 years of age is predicted to decrease birth rates by 5.64 percent.

In the GMM specification, the variable human capital is always statistically significant as well as female labor market participation. The relationship between democratization and birth rates vanishes once we introduce human capital in the regressions.

Table 4 – Democracy and Birth Rates: Introduction of Additional Covariates

	FE (1)	FE (2)	FE (3)	AB (4)	AB (5)	AB (6)
Log CBR_{t-1}	0.959***	0.981***	0.943***	0.5828***	0.8364***	0.5755***
	(0.0134)	(0.0062)	(0.0169)	(0.0666)	(0.0489)	(0.0825)
$Democracy_{t-1}$	-0.0050	-0.0033	0.0013	-0.0069	-0.0241***	-0.0043
	(0.0044)	(0.0036)	(0.0045)	(0.0055)	(0.0085)	(0.0042)
Log GDP pc_{t-1}	0.0093**	0.0008	-0.0012	-0.0003	-0.0103	-0.0035
	(0.0045)	(0.0050)	(0.0059)	(0.0062)	(0.0136)	(0.0069)
$Human\ Capital_{t-1}$	-0.0386***		-0.0564***	-0.3281***		-0.3123***
	(0.0106)		(0.0133)	(0.0562)		(0.0734)
$Labor\ Part_{t-1}$		-0.0002	0.0005		-0.0086***	-0.0037**
		(0.0003)	(0.0004)		(0.0023)	(0.0016)
Implied Cumulative	-0.1205	-0.1717	0.0224	-0.0166	-0.1473***	-0.0100
effect of Democracy	[0.2388]	[0.3447]	[0.7782]	[0.1550]	[0.0005]	[0.2568]
Implied Cumulative	0.2253	0.0423	-0.0201	-0.0007	-0.0631	-0.0083
effect of Income pc	[0.1087]	[0.8704]	[0.8446]	[0.9638]	[0.4099]	[0.6055]
Sargan test				[0.2099]	[0.0617]	[0.0954]
AR(2) test				[0.3283]	[0.9883]	[0.5067]
Observations	2297	2577	1677	2214	2477	1595
R^2	0.969	0.973	0.957			

Notes: The dependent variable is the logarithm of Crude Birth Rate and the sampling period goes from 1972 to 2000. Fixed Effects estimation results in columns (1), (2), and (3), with robust standard errors clustered at country level in parentheses. Arellano-Bond GMM estimates in columns (4), (5) and (6), with robust standard errors. We instrument for Crude Birth Rate using a double lag. The Sargan test is a test of overidentifying restrictions and the p-value for this test is in brackets. AR(2) is a test of serial correlation of order 2 and we reject at order 1 but do not reject at order 2, which is evidence of no serial correlation in the error term. The implied cumulative effect of democracy on birth rates is obtained by $democracy_{t-1}/(1 - \log CBR_{t-1})$ and the same applies for the implied cumulative effect of income per capita. The p-value given in brackets correspond to a nonlinear test of the statistical significance of this coefficient. $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$. Detailed data definitions and sources given in the appendix.

This relationship is not affected by the introduction of female labor market participation alone in the estimation. According to the estimates reported in column (6) one additional year of schooling is associated with a 31.2 percent decrease in birth rates while a 1 percentage point increase in female labor market participation is associated with a 0.37 percent decrease in birth rates. These results may mean that the effect of democracy, if it exists, works mainly through human capital accumulation.

Overall, democracy seems to affect birth rates mainly through human capital accumulation. This result is consistent with the mechanism proposed by Galor (2005) based on the role of human capital accumulation in explaining fertility declines.

5.2.2 Sensitivity to an alternative measure of democracy

In this section we will use the Polity Composite Index as an alternative measure of democracy. This index results from subtracting the Polity Autocracy Index from the Polity Democracy Index and originally ranges from -10 (strongly autocratic) to 10 (strongly democratic)[11]. The Polity Democratic Index and the Polity Autocracy Index are derived from codings of the competitiveness of political participation, the openness and competitiveness of executive recruitment and constraints on the chief executive. Both indexes range from 0 to 10.

Table 5 investigates the robustness of our findings to the introduction of the Polity Composite index to measure democracy.

Columns (1)-(4) report fixed effects estimates and columns (5)-(8) report GMM estimates of several specifications. The estimates in columns (1) and (5) correspond to the estimation of (1) which constitutes the baseline model. The variable democracy, as measured by the Polity Composite Index, is statistically significant in both columns even though the magnitude of the short term impacts is higher in the GMM specification. According to the results in column (5) a full transition from dictatorship to democracy would cause birth rates to decrease by 8.7 percent.

Once human capital and female labor market participation are introduced in the regressions the statistical significance of the estimates change in the same way as when using the Freedom House Political Rights Index to measure democracy. The

[11]We normalize the Polity Composite Index to range from 0(strongly autocratic) to 1(strongly democratic).

Table 5 – Democracy and Birth Rates: Polity IV Measure of Democracy

	FE (1)	FE (2)	FE (3)	FE (4)	AB (5)	AB (6)	AB (7)	AB (8)
Log CBR_{t-1}	0.987***	0.958***	0.976***	0.941***	0.850***	0.495	0.798***	0.564***
	(0.0070)	(0.0135)	(0.0071)	(0.0179)	(0.0551)	(0.6770)	(0.0514)	(0.0819)
$Democracy_{t-1}$	-0.0115***	-0.0109***	-0.0080**	-0.0034	-0.0872***	-0.0192	-0.0458***	-0.0118
	(0.0028)	(0.0034)	(0.0031)	(0.0043)	(0.0301)	(0.0134)	(0.0174)	(0.0073)
Log GDP pc_{t-1}	-0.0023	-0.0004	-0.00005	-0.0016	-0.0915***	-0.0562	-0.0184	-0.0047
	(0.0038)	(0.0036)	(0.0049)	(0.0060)	(0.0314)	(0.0609)	(0.0155)	(0.0069)
$Human\ Capital_{t-1}$		-0.0334***		-0.0547***		-0.3494		-0.3199***
		(0.0092)		(0.0131)		(0.4838)		(0.0707)
$Labor\ Part_{t-1}$			-0.0002	0.0005			-0.0082***	-0.0036**
			(0.0003)	(0.0003)			(0.0022)	(0.0015)
Implied Cumulative	0.8562***	-0.2624***	-0.3384***	-0.0566	-0.5821***	-0.0380	-0.2263***	-0.0271*
effect of Democracy	[0.0087]	[0.0024]	[0.0021]	[0.3894]	[0.0000]	[0.3614]	[0.0041]	[0.0895]
Implied Cumulative	-0.1695	-0.0093	-0.0020	-0.0273	-0.6105***	-0.1141**	-0.0910	-0.0108
effect of Income pc	[0.4225]	[0.9137]	[0.9922]	[0.7863]	[0.0000]	[0.0327]	[0.1850]	[0.4848]
Sargan test					[0.2979]	[0.4908]	[0.0279]	[0.1582]
AR(2) test					[0.4603]	[0.3869]	[0.9540]	[0.4513]
Observations	4340	3112	2578	1677	4240	3029	2478	1595
R^2	0.980	0.976	0.974	0.957				

Notes: The dependent variable is the logarithm of Crude Birth Rate and the sampling period goes from 1960 to 2000. Fixed Effects estimation results in columns (1), (2), (3), and (4) with robust standard errors clustered at country level in parentheses. Arellano-Bond GMM estimates in columns (5), (6), (7) and (8), with robust standard errors. We instrument for Crude Birth Rate using a double lag. The Sargan test is a test of overidentifying restrictions and the p-value for this test is in brackets. AR(2) is a test of serial correlation of order 2 and we reject at order 1 but do not reject at order 2, which is evidence of no serial correlation in the error term. The implied cumulative effect of democracy on birth rates is obtained by $democracy_{t-1}/(1 - \log CBR_{t-1})$ and the same applies for the implied cumulative effect of income per capita. The p-value given in brackets correspond to a nonlinear test of the statistical significance of this coefficient. $^*p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$. Detailed data definitions and sources given in the appendix.

short term causal effect of democracy in birth rates is not robust to the introduction of human capital in the fixed effects estimation. The short term relationship between democratization and birth rates also vanishes once human capital and female labor market participation are jointly introduced in the GMM specification. The long term impact of democratization in birth rates is statistically significant in almost all specifications. According to the estimates presented in column (6) full democratization is associated a 2.71 percent decrease in birth rates in the long term after controlling for income per capita, human capital and female labor market participation.

The main conclusion from these results is the robustness of our findings to the introduction of the Polity Composite Index as an alternative measure for democracy.

6 Instrumental Variables Estimation

When discussing the estimation strategies to be adopted in order to estimate the causal effect of democracy on birth rates we pointed the importance of exogenous sources of variation in estimation.

In this section we account for the serious possibility that democracy is endogenous in equation (1) and suggest an instrument for this variable. The possibility of endogeneity is empirically testable. We use the Hausman test for endogeneity by estimating the following augmented OLS regression:

$$y_{it} = \gamma y_{it-1} + \delta d_{it-1} + \rho \widehat{d}_{it-1} + \mathbf{x}'_{it-1}\beta + \alpha_i + \varepsilon_{it} \tag{3}$$

where $\widehat{d}_{it-1}$ is the predicted value of the endogenous regressor from reduced form regression of d_{it-1} on the instrument f_{it-1} and on the other exogenous variables. Hausman (1978) showed that we can test whether $\rho = 0$ in (3) since evidence for correlation between ε_{it} and d_{it-1} would be given by statistical significance of transformations of d_{it-1} such as $\widehat{d}_{it-1}$. The results of the Hausman test for endogeneity reported in Table 9 suggest empirical evidence that democracy is endogenous is our model since we reject the null hypothesis of $\rho = 0$ for all significance levels in both specifications.

Persson and Tabellini (2006) constructed a measure of a country's democratic capital based on the nation's historical experience of democracy and a measure of the

foreign, neighboring countries' democratic capital. The measure of the neighborhood democratic capital is based in a geographic definition of closeness and a continuous measure of democracy based on Polity IV data. It consists of a weighted average of the continuous variable polity2 in neighboring countries and the weights are the distances between capitals. The variable polity2 considers six aspects of political institutions focusing on executive powers, executive selection and the freedom of elections, and ranges from -10 to 10.

Specifically, for country i and year t, the authors define *foreign* democratic capital, $f_{i,t}$, by

$$f(\rho)_{i,t} = \sum_{j \neq i} (1 - a_{j,t}) \varpi(\rho)_t^{i,j}$$

where $a_{j,t}$ is a measure of the degree of democracy in country j in year t, $\varpi(\rho)_t^{i,j}$ are the weights which fall with the distance between i and j and drops to zero for distance outside the radius ρ. The authors replace $(1-a_{j,t})$ by country's j's continuous *polity2* score and divide by 10, such that the resulting expression is scaled from 0 to 1. Therefore, $f_{i,t}$ measures a country's "closeness of democracy" given the prevalence of democracy in neighboring countries.

We expect the democratic capital of neighboring countries to influence positively the domestic democratic capital of a country. As proposed by these authors, "it is easy to imagine how experience with democracy in foreign, neighboring countries could spill over into greater domestic appreciation of democracy and greater willingness to defend these values; think about the orange revolution in the Ukraine".

We argue that democracy is endogenous in our model and suggest to use instrumental variables as estimation strategy to deal with this problem.

To analyze the impact of democracy on birth rates using an instrumental variables approach we use two main specifications, with and without GMM.

The first stage equation for democracy in regression (1) is the following:

$$d_{it} = \alpha_i + \gamma f_{it} + \mathbf{x}_{it}' \beta + \varepsilon_{it} \tag{4}$$

where f_{it} represents the instrument *foreign* democratic capital for country i at time t. In this case, the condition $Cov(f_{it}, \varepsilon_{it} | \mathbf{x}_{it}, \alpha_i) = 0$, where ε_{it} represents the residual

error term in the second stage equation, is crucial for identification.

The first-stage results suggest a strong relation between democracy and *foreign* democratic capital. For example, the first-stage results for the regression in column (2) of Table 6 (within variation case) yield a coefficient of approximately 0.27 with a t-statistic close to 2.6.

Table 6 reports the estimates for three estimation strategies using the two measures of democracy. The first is the standard 2SLS regression, the second is the fixed effects 2SLS regression, and the third is the Arellano-Bond GMM regression. The estimates suggest a statistically significant negative impact of democracy in birth rates in all specifications and using either of the two measures of democracy. We also find a statistically significant long term effect of democracy in birth rates. The results in columns (1) and (4) suggest a significant negative cross-sectional relation between birth rates and democracy. According to column (2), an autocratic country that experiences a full development of institutions is estimated to have a decrease in birth rates of 16.4 percent, approximately. The magnitude of the short term effect of democracy in birth rates using the Polity Composite Index as democracy measure is smaller. According to column (5) a country that experiences a full transition from dictatorship to democracy verifies a decrease of 5.8 percent in birth rates. The estimated impacts using the GMM procedure are reported in columns (3) and (6). The estimated long term effect of a full development of institutions in column (3) is associated with a decrease in birth rates given by -0.034/(1-0.8960)=-0.3312*100 percent. This implied effect of democracy in the long term is highly statistically significant. The GMM estimates suggest a higher impact of democratization in birth rates. A transition from dictatorship to democracy implies a 7.54 percent decrease in birth rates in the short term and a 50.06 percent decrease in the long term.

Overall, the predicted impact of democratization in birth rates is strong and robust to the introduction of country-specific fixed effects.

In 2006 the Freedom House Political Rights Index attributed the lowest rating of institutional development to Libya (dictatorship) and the CBR in Libya was 23.752 in that year (the CBR in Sweden in 2006 was 11.664). Given the estimates reported in column (3) the predicted short term reduction in birth rates implied by Libyan full development of institutions would be equal to 0.82 which is quantitatively small if we consider the gap between Libya and Sweden for example. In contrast, the long

Table 6 – Democracy and Birth Rates: IV Estimation

	Freedom House Measure			Polity IV Measure		
	2SLS (1)	FE 2SLS (2)	AB (3)	2SLS (4)	FE 2SLS (5)	AB (6)
Log CBR_{t-1}	0.981***	0.931***	0.8960***	0.986***	0.964***	0.8494***
	(0.0148)	(0.0142)	(0.0370)	(0.0063)	(0.0112)	(0.0619)
$Democracy_{t-1}$	-0.0629**	-0.164***	-0.0344***	-0.0398***	-0.0580***	-0.0754**
	(0.0295)	(0.0300)	(0.0097)	(0.0115)	(0.0118)	(0.0293)
Log GDP pc_{t-1}	0.0041	0.0114***	-0.0277*	-0.0003	-0.0083	-0.0924***
	(0.0032)	(0.00341)	(0.0155)	(0.0016)	(0.0051)	(0.0340)
Implied Cumulative	-3.2375***	-2.3741***	-0.3312***	-2.7462***	-1.5887***	-0.5006***
effect of Democracy	[0.0095]	[0.0000]	[0.0004]	[0.0001]	[0.0000]	[0.0000]
Implied Cumulative	0.2083	0.1652***	-0.2668***	-0.0185	-0.2276***	-0.6134***
effect of Income pc	[0.3682]	[0.0034]	[0.0083]	[0.8669]	[0.0062]	[0.0000]
Sargan test			[0.5078]			[0.2311]
AR(2) test			[0.8062]			[0.4807]
Observations	2816	2816	3601	3799	3799	3601
R^2	0.996	0.936		0.996	0.970	

Notes: The dependent variable is the logarithm of Crude Birth Rate and the sampling period goes from 1972 to 2000. Two-stage least squares (2SLS) estimation results in columns (1) and (4), with robust standard errors clustered at country level in parentheses. Fixed effects 2SLS results in columns (2) and (5) with country fixed effects and robust standard errors clustered at country level in parentheses. Arellano-Bond GMM estimates in columns (3) and (6) with robust standard errors. Democracy is instrumented in the first differenced equation with differenced *foreign* democratic capital. The Sargan test is a test of overidentifying restrictions and the p-value for this test is in brackets. AR(2) is a test of serial correlation of order 2 and we reject at order 1 but do not reject at order 2, which is evidence of no serial correlation in the error term. The implied cumulative effect of democracy on birth rates is obtained by $democracy_{t-1}/(1-\log CBR_{t-1})$ and the same applies for the implied cumulative effect of income per capita. The p-value given in brackets correspond to a nonlinear test of the statistical significance of this coefficient. $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$. Detailed data definitions and sources given in the appendix.

term effect of political development in birth rates may be considerable. Full political development in Libya would cause a decrease of 7.77 in CBR, closing the gap between the two countries.

Empirical results concerning the impact of income per capita in birth rates appear with the "wrong" sign in columns (1) and (2). In column (3) an increase in income per capita is associated with a significant decrease in birth rates, but the impact is small. A 10 percent increase in income per capita leads to a decrease of 0.3 percent in birth rates. These results contribute to the inconclusive empirical literature regarding the sign of the relationship between income and birth rates.

7 Conclusion

The theories of demographic transition ignore the role of political institutions in explaining fertility declines. Standard regressions to explain the relationship between fertility rates and institutions in the literature do not account for the strong persistence in CBR, the possibility of relevant unobserved characteristics which are likely to be correlated with the exogenous regressors or to the possibility of reverse causation. The political economy literature has pointed to the importance of cultural values, traditions, institutionalization, and ideologies in explaining democratization. These factors are also likely to influence birth rates. Therefore, changes in democracy and changes in birth rates may be driven by a third variable, which may be time-variant or time-invariant.

In this paper we look for a causal link between democracy and birth rates using two strategies: the first is the inclusion of country-specific effects in the estimation in order to control for time-invariant omitted factors, and the second is the use instrumental variables estimation, by using the democratic capital of the neighbors as an exogenous source of variation for democracy.

All in all, we find empirical evidence which supports a significant negative causal relationship between democracy and fertility that is robust to the introduction of fixed effects and to a dynamic model structure. We used the democratic capital of the neighbors as an instrument for a country's democracy and find significant evidence that changes in democracy are negatively associated with changes in birth rates. A

country that becomes more democratic is likely to have lower birth rates, holding the other country characteristics constant. Therefore, political development constitutes an additional mechanism to explain fertility declines experienced worldwide. This result may have important policy implications. Politicians may affect fertility rates and the population size by better securing property rights and ensuring contract enforcement or creating incentives for female labor market participation, for example.

A well established result in the economic growth literature says that fertility rates are a negative determinant of long-run economic growth. In this way, politicians have an additional instrument that has been over looked to escape a Malthusian trap or to promote further economic development by directly affecting birth rates and the population size.

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Table 7 – Democracy and Fertility Rates

	Pooled OLS (1)	Pooled OLS (2)	Fixed Effects (3)	Arellano-Bond GMM (4)
Democracy	-0.473***			
	(0.112)			
Log GDP per capita	-0.273***			
	(0.0369)			
Log TFR_{t-1}		1.001***	0.993***	0.9851***
		(0.00212)	(0.00472)	(0.0083)
$Democracy_{t-1}$		0.00512*	-0.00579	-0.0237***
		(0.00302)	(0.00356)	(0.0071)
Log GDP per $capita_{t-1}$		0.0197***	0.0122***	0.0122***
		(0.00123)	(0.00338)	(0.0042)
Implied Cumulative		-6.2401	-0.87752	-1.5862**
effect of Democracy		[0.6777]	[0.1500]	[0.0229]
Implied Cumulative		0.3420	2.9895	0.8178
effect of Income per capita		[0.8697]	[0.1876]	[0.1539]
Sargan test				[0.2340]
AR(2) test				[0.7890]
Observations	3446	3329	3329	3223
R^2	0.630	0.998	0.989	

Notes: The dependent variable is the logarithm of Total Fertility Rate and the sampling period goes from 1972 to 2006. Pooled cross-sectional OLS regressions in columns (1) and (2) with robust standard errors clustered at country level in parentheses. Fixed effects OLS regression results in column (3) with country fixed effects and robust standard errors clustered at country level in parentheses. Column (4) reports estimation results using the Arellano-Bond estimator (see Arellano and Bond (1991)) with two lags used to instrument democracy and with robust standard errors. The Sargan test is a test of overidentifying restrictions and the p-value for this test is in brackets. AR(2) is a test of serial correlation of order 2 that we reject at order 1 but do not reject at order 2, which is evidence of no serial correlation in the error term. The implied cumulative effect of democracy on birth rates is obtained by $democracy_{t-1}/(1 - \log TFR_{t-1})$ and the same applies for the implied cumulative effect of income per capita. The p-value given in brackets corresponds to a nonlinear test of the statistical significance of this coefficient. $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$. Detailed data definitions and sources given in the appendix.

Table 8 – Democracy and Fertility Rates: IV Estimation

	Freedom House Measure			Polity IV Measure		
	2SLS (1)	FE 2SLS (2)	AB (3)	2SLS (4)	FE 2SLS (5)	AB (6)
Log TFR_{t-1}	0.985***	0.964***	0.9314***	0.993***	0.995***	0.955***
	(0.0188)	(0.0083)	(0.0247)	(0.00724)	(0.00534)	(0.0273)
$Democracy_{t-1}$	-0.0508	-0.114***	-0.0318***	-0.0293*	-0.0206**	-0.0425**
	(0.0476)	(0.0228)	(0.0088)	(0.0169)	(0.00861)	(0.0175)
Log GDP pc_{t-1}	0.00392	0.0214***	0.0054	0.000299	0.00173	-0.0548***
	(0.0032)	(0.0026)	(0.0076)	(0.00156)	(0.00308)	(0.0175)
Implied Cumulative	-3.3355**	-3.1289***	-0.4644***	-3.9614	-4.1351	-0.9473***
effect of Democracy	[0.0101]	[0.0000]	[0.0007]	[0.0481]	[0.1654]	[0.0023]
Implied Cumulative	0.2570	0.5891***	0.0792	0.0404	0.3482	-1.2220***
effect of Income pc	[0.3491]	[0.0001]	[0.5264]	[0.8523]	[0.7107]	[0.0023]
Sargan test			[0.3677]			[0.2892]
AR(2) test			[0.9290]			[0.4341]
Observations	2803	2803	3588	3790	3790	3588
R^2	0.997	0.974		0.997	0.987	

Notes: The dependent variable is the logarithm of Total Fertility Rate and the sampling period goes from 1972 to 2000. Two-stage least squares (2SLS) estimation results in column (1), with robust standard errors clustered at country level in parentheses. Fixed effects 2SLS results in column (2) with country fixed effects and robust standard errors clustered at country level in parentheses. Arellano-Bond GMM estimates in column (3) with robust standard errors. Democracy is instrumented in the first differenced equation with differenced *foreign* democratic capital. The Sargan test is a test of overidentifying restrictions and the p-value for this test is in brackets. AR(2) is a test of serial correlation of order 2 and we reject at order 1 but do not reject at order 2, which is evidence of no serial correlation in the error term. The implied cumulative effect of democracy on birth rates is obtained by $democracy_{t-1}/(1 - \log TFR_{t-1})$ and the same applies for the implied cumulative effect of income per capita. The p-value given in brackets correspond to a nonlinear test of the statistical significance of this coefficient. $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$. Detailed data definitions and sources given in the appendix.

Table 9 – Hausman Test for Endogeneity

	2SLS (1)	Fixed Effects 2SLS (2)
Log CBR_{t-1}	0.980***	0.931***
	(0.00675)	(0.0151)
$Democracy_{t-1}$	0.00477*	-0.00491
	(0.00243)	(0.00384)
$\widehat{Democracy}_{t-1}$	-0.0697***	-0.161***
	(0.0192)	(0.0317)
Log GDP pc_{t-1}	0.00417**	0.0113***
	(0.00176)	(0.00321)
Observations	2816	2816
R^2	0.998	0.973

Notes: The dependent variable is the logarithm of Crude Birth Rate and the sampling period goes from 1972 to 2000. Two-stage least squares (2SLS) estimation results in column (1), with robust standard errors clustered at country level in parentheses. Fixed effects 2SLS results in column (2) with country fixed effects and robust standard errors clustered at country level in parentheses. $*p < 0.1$, $**p < 0.05$, $***p < 0.01$. Detailed data definitions and sources given in the appendix.

Table A1 Data Description and Sources

Variable	Description	Source
Democracy	Refers to political freedom and is measured using the Freedom House Index of Political Rights and provides a measure of the extent of democracy in a given country. Political rights are measured on a one-to-seven scale, with one representing the highest degree of Freedom and seven the lowest, here normalized from 0 to 1, with 1 representing fully developed democratic institutions	The source of these data is the Freedom House (1972-2006)
Polity Composite Index	Computed by subtracting the autocracy score from the democracy score. This index ranges from -10 (strongly autocratic) to 10 (strongly democratic) and is normalized to range from 0 (strongly autocratic) to 1 (strongly democratic).	Polity IV Project (1960-2006)
Crude birth rate	Indicates the number of live births occurring during the year, per 1,000 population estimated at midyear	World Bank (1960-2006)
Foreign Democratic Capital	Defined by Persson and Tabellini (2006) and also normalized from 0 to 1. It is the weighted average of the continuous variable polity2 in neighboring countries, taken from PolityIV dataset. The weights correspond to the distance between capitals.	Persson and Tabellini (2006)
GDP per capita	Measured as logarithm of GDP per capita adjusted for purchasing power parity.	Penn World Table 6.3 by Heston, Summers, and Aten (2009)
Human Capital	Years of schooling os the population above 25 years of age. Interpolation of five-year observations from Persson and Tabellini (2006).	Persson and Tabellini (2006), **?**
Labor Participation	Labor force participation rate is the proportion of the female population ages 15 and older that is economically active.	World Bank (1980-2006)
Total fertility rate	Represents the number of children that would be born to a woman if she were to live to the end of her childbearing years and bear children in accordance with current age-specific fertility rates.	World Bank (1960-2006)

Table A2 Countries included in the sample

Country			
Albania	Guatemala	Mozambique	Turkey
Algeria	Guinea	Netherlands	Uganda
Angola	Guyana	New Zealand	United Arab Emirates
Argentina	Haiti	Nicaragua	United Kingdom
Australia	Honduras	Niger	United States
Austria	Hungary	Nigeria	Uruguay
Belgium	Iceland	Norway	Vietnam
Bolivia	India	Pakistan	Yemen Rep.
Brazil	Indonesia	Panama	Zambia
Bulgaria	Iran	Paraguay	Zimbabwe
Burkina Faso	Iraq	Peru	
Cameroon	Ireland	Philippines	
Canada	Italy	Poland	
Chile	Ivory Coast	Portugal	
China	Jamaica	Romania	
Colombia	Japan	Saudi Arabia	
Congo Rep.	Jordan	Senegal	
Congo Dem. Rep	Kenya	Sierra Leone	
Costa Rica	Korea Rep.	Singapore	
Cuba	Lebanon	Somalia	
Denmark	Liberia	South Africa	
Dominican Republic	Libya	Spain	
Ecuador	Luxembourg	Sudan	
Egypt Arab Rep	Madagascar	Sweden	
El Salvador	Malawi	Switzerland	
Finland	Malaysia	Syrian Arab Republic	
France	Mali	Tanzania	
Gabon	Mexico	Thailand	
Ghana	Mongolia	Togo	
Greece	Morocco	Trinidad and Tobago	